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A STUDY OF DREAMS.

BY JULIUS NELSON.

Every psychological inquiry should as far as possible be based upon and connected with so much of physiological knowledge as we can command. It is not our desire to do this in the present article in any thorough manner, but for the purposes of introduction and orientation a few primary principles may be premised.

Look at the subject from whatever point of view we may, we cannot escape the fundamental conclusion that the human body, in its entirety, is a *cell-state or colony*. The individual acquires his character as a *unit* from the extreme differentiation and consequent division of labor obtaining among the cell units. There can therefore, in reality, be no *new* physiological or psychological function or faculty or characteristic in the soma which was not and is not in the cells. If the complex body seems to differ markedly in its powers from the simple cell, it is because the work

necessary to sustain the life of a cell has been distributed among many units, and thus many diverse combinations and interrelations of the cell functions become possible. Nutrition and growth (and reproduction), respiration and movement, irritability or response to stimuli, heredity and variability, and probably spontaneity or will, are the fundamental properties of protoplasm in its simplest state. All other powers of living things are secondarily derived by evolution (*i. e.* differentiation) of these primary properties, due to the *educating* forces of the environment acting through time. All these questions in biology and psychology, then, ultimately rest on cell physiology. We know very little about cell physiology, but we do know a few facts the knowledge of which will prevent us from making rash statements about the relations of brain cells to mental processes, such as are frequently made and which carry the air of final explanations. Such statements are, that images, stimuli, ideas, are impressed on the cell protoplasm just as if it were a photographic plate, and that consciousness simply "reads" these impressions. Memory is the strength with which protoplasm retains the impressions. When we learn a new thing it is stored up in a new cell, or a new connection between old cells is made. Finally it is asserted that nerve force (or at least stimuli), once flowing along a certain line or direction, maps out a "path," along which it becomes easier for it to flow next time, and so we form habits. The nerve fibres are supposed to represent the morphological result of such flows of force.

All this is crude fancy and finds no support in modern cytology. All the changes that take place in cells are undoubtedly chemical and physical. But the

actions of cell life are not explained even were we able to write the whole equation of the correlation and transformation of the forces present. We would still have to account for the *reason* of the change, for the organization of these forces, and, in fact, for that which makes the phenomena *vital* as distinguished from non-living chemical transformations. We know that complex chemical compounds are built up in cells with attendant absorption of oxygen. This requires energy, and that is furnished by the breaking down of the highly complex substances furnished by the food in the lymph and blood. Then when the cell works there is a liberation of energy due to the breaking down of these highly complex molecules, and waste products are thrown into the blood. The latest researches seem to show that, if not all the energy of a working cell, at least a great deal more than was formerly supposed, is furnished by the breaking down, not of the food directly, but of the living substances of the cell, which have themselves been built up out of the food. This is shown by the remarkable chemical and morphological changes which the *chromatin* of the nucleus undergoes when cells are active.

It is the chromatin, as we have shown elsewhere,¹ and as is now widely believed among cytologists, that is, as it were, the *brain* or *soul* of the cell. In it inheres the psychic or hereditary powers; and if it be removed from a cell, the rest of the protoplasm behaves automatically. The cell then moves mechanically, cannot reconstruct itself, and finally wears itself out and decomposes.² The difference between the chromatin

¹ "The Significance of Sex." *American Naturalist*, January, February and March, 1887.

² See Gruber, "Beiträge zur Kenntniss der Physiologie und Biologie der Protozoen." *Bericht Naturforschenden Ges. Freiburg*, Vol. I, 1886.

and chemical substances that are devoid of chromatin is this. In the latter case any drug or stimulus produces an effect in accordance with fixed laws, but the chromatin has the power of interpreting stimuli, and its reactions are intelligently directed towards the preservation of its own life, and thus of the cells, and hence of the body. When a poison is absorbed by a cell, such poison forms chemical compounds with the protoplasm (therefore it is a poison), but the chromatin does not allow itself passively to be destroyed, but at once manufactures more chromatin as fast as it can, and thus supplies more than sufficient to satisfy the poison, and then the cell proceeds to excrete the saturated compounds.¹ In this way the chromatin can be *educated* to endure a great quantity of poison.²

The morphological structure of cells is such as the conditions of nature have shown necessary and advantageous for allowing the chromatin to live and grow, to differentiate, to receive stimuli, and to react upon the external world. Hence we have the chromatin in one or many spherical bodies in a nucleus, and the whole encompassed by cell plasma that serves it for a house and for organs of relation. The structure of cells, therefore, is such as enables them best to do their work, such as absorbing food and moving by pseudopodia or cilia. There is not the slightest hint of structure with relation to anything else. They who think the complex structure of higher animals is in some way mirrored in their cells, or in the cytological structure

¹ See Stolnikow, "Vorgänge in den Leberzellen, insbesondere bei der Phosphorvergiftung." *Du Bois Archiv*, 1887, *Phys. Abth.* Supplement.

² Should later studies show that this reaction is not so simple a one as Stolnikow assumes in interpreting his sections, the general fact of the educability of protoplasm still remains.

of the eggs from which the cells are the descendants, do greatly err and have not conceived the problem of heredity from the vital and psychic standpoints. Cytologically at least, the ovum of a complex animal is as simple, even simpler than many of the single celled animals. In the same way must we think of the brain cells as in no great respect different from other cells. All cells are endowed with the fundamental properties of living matter, and when differentiation comes in, it is simply a distribution of these properties. A nerve cell is one differentiated especially to receive and react to stimuli in such relations or connections as to correlate organs. A muscle cell is one so constructed as to react by manifesting as great an amount of motion as possible. When a nerve cell acts there must be a breaking down of chromatin, just as when a liver cell acts. Who can prove that a splitting up of chromatin in the one case differs from that in the other, and who can imagine how such difference can account for consciousness or any psychic characteristic of ideas and sensations? Can we conceive that food which a little while ago was solvent in the lymph, and now has been built up into a complex molecule of chromatin, can remember, when a vibration reaches it and causes it to break up, that the chromatin which was its predecessor was broken up by a stimulus of like kind, (even supposing that the nerves are differentiated so as to transmit different sorts of vibrations or stimuli for the different sorts of external excitants, which is indeed an open question)? We see, then, that if anybody wishes to believe in *spirit* apart from matter, that this spirit can be *organized* and be an immaterial governor of material forces with which it can be in mysterious connection, and that the properties of spirit

and of matter are in no way similar, but totally dissimilar, such belief is in no way shaken by the very most recent advances of biological science.

We have seen that when a cell acts in any manner there is a degradation of chromatin. If this activity breaks down the chromatin faster than it can be built up, the cell must stop and rest. This resting, when it takes place in the higher psychic centres, presents the phenomenon of sleep. Only a few cells of the body sleep, and, as many parts of the brain are nowise tired out, they may still act during sleep. If these are the cells involved in psychic processes of some sort or other, we get dreams. In order that the tired brain cells may be allowed to rest undisturbed, the vital functions of the body are lowered to a minimal intensity. The easiest position is assumed, secluded from stimulation from the external world, because many of the cells are in good and increasingly good condition to react on stimuli, so that if these are not shut out, the restoration would be interfered with. Here, *habit* controls the action ; for when the cells receive stimuli that have no significance for the welfare of the body, they do not *react*. The cells have to be educated to this attitude, for when unusual stimuli, as from a strange sleeping place, strike the senses, our sleep is more or less disturbed.

The blood does not flow so much to the brain during sleep, yet it is not altogether shut out, because food and oxygen are needed to restore the tired cells. This fact has much significance, for we know that when an organ acts it receives an extra amount of blood, and that in a general way the character of our mental activities is controlled by the amount of blood in the acting cerebral ganglia. It is therefore quite possible

that some ganglionic cells act in a feeble way all night, but, because of the feebleness of the action, we never recollect anything about it. But there may be disturbing causes, such as irregularity in the relations of controlling centres, or stimuli from diseased or uncomfortable organs, that tend to set certain ganglia into activity and call an increased flow of blood to the part, and thus vivid dreams will arise. As morning approaches, and the cells have gotten well rested and are quite irritable, they are ready to "explode" their chromatin at slight offence, and at last there is a general awakening, which is accompanied by a return of blood to the brain. There cannot help but be a "dawn" in consciousness just before getting awake and becoming aware of the external world, and thus people generally wake up out of a dream state. Of course the character of dreams will depend on several factors, such as the extent of the brain involved, the amount of irritability, and in a general way to the sort of stimulus, and of course on the interests, education and experiences of the individual in the immediate past.

There is undoubtedly one common psycho-biological law explaining the activities of the brain cells; how they act on a common stimulus producing a sensation; what is involved in perception, in an apperception; what in recollection; what in memory; what in reasoning; what in volition; what in desiring, and in emotions. How are the cells related; what cell activities are primary and what are secondary; which cells are exciting and which inhibitory? These are questions that must be answered before normal psychic action can be comprehended. Then we shall be in a fair way to readily comprehend how we get all degrees of disturbance of these normal relations leading down to the

deepest insanity. We shall then see why there is such a marked similarity among the different sorts of abnormal manifestations, such as the hallucinations of insanity, the delusions of hypnotism, the experiences of the dreamer, the fancies of revery, and still other facts in anthropology.

Although the ultimate solution of these problems depends on advances in the science of cell physiology, we need also to know all that other methods of study will yield. We must know gross anatomy before histology. I took up the study of dreams as a convenient portal to the general subject of hallucinations, and with the hope of adding to our knowledge of this most fascinating field of psychology. In the month of November, 1884, I began recording my dreams, and have accumulated the records of over one thousand dreams per year since that date. Two thirds of these are more or less elaborately detailed, so that we have here a great quantity of matter which will require much time to properly and thoroughly study. The present article is only a preliminary report due to a general survey of the data, and serving to introduce more detailed studies to follow later. It is to be hoped it may also stimulate others to study their own dreams at least ; for only by comparison are we able to generalize and to discover what is idiosyncratic in these manifestations.

In many cases it helps a student to become thoroughly familiar with the work and theories of others in the special line he proposes to follow, to serve as a guide and to prevent the waste of misdirected efforts. In this study, however, it is best to read sparingly until considerable headway has been made in one's own method ; the reason being that much of the literature in this

line is more of a poetical than of a scientific nature, and that a tendency to view one's own states with a special bias is readily and unavoidably given. There is a tendency to be interested in the *matter* of the dreams, in its æsthetic effects, much as we react towards ideas and events of real life in relation to our well-being. Of course this is the unscientific standpoint. The fact that a person dreams much or little is of more significance than *what* one dreams. A curve representing the variations from day to day in the amount of dreaming has scientific interest, while the hobgoblins that we saw are of interest to children.

The introspective method has two stages. At first we simply observe the phenomena presented by nature in their serial and concurrent relations, and from the light thus afforded we are enabled to experiment or to control certain conditions with advantage and intelligence. So far I have confined myself to the first of these methods.

There are a few pertinent biographical details that should accompany each student's memoir. I may be said to possess the dreamy diathesis in a strong degree, manifested from early childhood to the present time, a period of 30 years. My mental make-up is inherited mostly from the paternal side and is erethic in quality. The nutritive functions have been derived from the maternal side and present an irritable digestive system. My father rarely dreams, but my mother has many dreams in which she takes great interest. My memory is strong only in its visualizing power.

As a child I was subject to cramps, costiveness, and nightmares. The interrelation of these facts is evident. In regard to health, I have improved steadily with age.

Dreams that occurred before my fifth year of life are quite as vivid in my memory as the few waking

scenes of that period which I can recall. In the period lying between my eighth and twelfth years my dreams were peculiarly troubled ; but at present my recollection of them is vague. On retiring I reviewed the events of the day over and over again, introducing variations and often new chapters with the slightest effort, yet had I undertaken to write a novel I should have failed. Often before my eyes there appeared mosaics of colors, expanding and contracting or rotating ; and this especially if my eyes were shut. At times I could see malign faces appear on the walls with great reality and distinctness. If no nightmare caused me to awake during the night, the dream, however pleasant, always took a disagreeable and frightening turn on waking in the morning. I felt myself lifted up as if gravity had temporarily reversed its action, and then I was dropped from a great height back to earth, which I neared in increasing fear and loss of breath. But I always awoke just before striking the ground and when the fear seemed to be at a climax. Some mornings a pleasant dream would be substituted, and when the pleasures of anticipation of some rare treat were at a climax, just as the treat was about to be enjoyed, I awoke.

My mother taught me a remedy for bad dreams which I applied with immediate and universal success, viz., on composing myself for sleep, the object of a dreaded dream was by voluntary act brought before my mind, and while held there I said mentally, " Shall I dream of that ? " (here visualizing the scene which past dreams had taught me to fear), and then the subject was dismissed with a confidence that I should not be troubled by that dream for that night. Should the feared scene again intrude into consciousness

before sleep came, it must once more be dismissed by the formula or my work were vain. Thus one by one I rehearsed the list of bugbears every night, making special effort not to treat pleasant subjects in like way, for then I knew they would not be dreamed about. By this means the mind passes from a state of fear, where the image haunts it, to one of confidence and control, where by some automatic action, similar to that by virtue of which we can wake up at a set time, the mind retains control throughout sleep.

I am subject to three distinct classes of dreams, which for convenience may be designated respectively (1) evening dreams, (2) night dreams, (3) morning dreams, as showing the time of the sleeping period when they most generally take place. Perhaps a fourth class could be added, viz., those excited by digestive derangements, such as nightmares; but they are rather modifications of the others, due to extra exciting causes at work for a definite period during any portion of the night. The first two classes are rare dreams; the third class makes up the main bulk of the dream record.

Class I. This takes place only when I can manage to get to bed when very tired and very sleepy, without getting thoroughly awake in the effort to doff my clothes. I am then in a semi-somnambulistic condition, while still conscious of my surroundings. While in this state I suddenly experience a nervous discharge which throws many of my muscles, sometimes including those of voice, into violent activity, as in a single twitch, so brief is the action. I have the sensation of passing out of a comatose state into the ordinary state, which is followed by tranquil sleep. Never has sleep proper followed such a state without this sudden dis-

charge and feeling of psychic change. Dreams often accompany this state whose tragic climax coincides with the discharge. Psychically the discharge is felt as the effort of the body to escape the impending danger, not through voluntary but through reflex action. Once, after severe exercise of skating, I retired with the sensations of the movements and scenes of the day reverberating through my nerves. While still conscious of my room, I lay reviewing the scenes of the day as they whirled by with unwonted vividness, until suddenly they became real, I was dreaming, a hole in the ice developed, into which I fell with a shriek and a struggle that was real and no dream, much to the amusement of my bedfellow. Had this been an ordinary dream I could have experienced the same series of psychic phenomena without the muscular movement. These dreams occurring immediately after retiring have no real sleep connected with them, while ordinary dreams accompany waking from sleep of longer or shorter duration. A strange sense of reality may sometimes be present when the scene of the dream is laid in my bedroom and I am conscious of being in bed ; then on waking there is nothing to prove that it was a dream except the peculiar circumstance which the dream introduced. Thus one evening after composing myself for sleep I saw a white figure approach my couch. Full of dread, I threw up my arm to ward off the spectre, and awakening, it immediately vanished. On learning that no one had entered the room, the sudden and unreal way in which it vanished, and reflecting that had I been awake I should not have been frightened, and not being a believer in ghosts, I concluded it must be a dream. Thus a process of ratiocination was required to properly characterize the phenomenon.

Class II. This class results from excessive stimulation of psychic or sensory organs, by which, to use a material figure, the molecules of the nervous substance are so set in vibration that they continue to vibrate during a large part of sleep. Such reverberations are felt during the waking period as well. The boy who has spent a glorious Fourth of July retires with the booming of guns and the blaze of fireworks before his mind, and these images haunt his dreams in grotesque forms. The student, after hard work at his algebra, has similar experiences with x 's, y 's and z 's. Sleep is disturbed; the brain is too full of blood to allow perfect sleep, and real rest comes not for hours. Perhaps the mind works, even in a logical manner, to solve vexed questions, though this must be seldom.

The dreams of Class III, as we shall see, are very different things; but before taking up this class, a few words about the dreams which we may designate as Class IV. Violent palpitations of the heart and intense peristaltic writhings of the intestines accompany such dreams in my case. Here I do not suppose the dream is to be considered secondary to the physical phenomena, but rather that by nervous or psychic sympathy the physical organ is reacted upon by dreams which it originally excited and determined the character of.

Class III, morning dreams. These occur when the brain has had a period of rest and repair; perhaps we may speak of it as a period of bloodlessness, and now, on waking, blood is rushing in, with a rapid rise of blood pressure in the brain. They differ also from other dreams in the faintness of their images, by virtue of which they are almost immediately erased from consciousness by external stimuli received on awaking. They

differ also from the foregoing classes in the fact that they are new or varied combinations of past mental experiences, worked up with great fertility of fancy and multiplicity of transformation. Events of the day before, preferably scenes of two days ago (as if those of yesterday were not faint enough) which have been forgotten, so trivial were they, are set in a background of scenes of my boyhood. The most trivial act of attention to an object one passes on the street, which would never again be thought of, is often the "hero" of a dream scene. No new sensations are introduced into these dreams ; but just as soon as a new sensation is experienced in waking life, is it seized upon as material for these creations, which are after all only grotesque combinations, although exceedingly real in that they possess the detail and completeness of natural scenes. One may dream of riding on the cars who has never ridden on them, but his sensations will be simply those he imagined while awake, when thinking of the subject. Not until a person has ridden on the cars can he experience in dream the true sensation thereto belonging. This law holds in my case with every possible experience of life.

On the transformation of dream scenes.—In waking life one may see a person in the distance approaching who may be judged in all confidence to be Mr. A. On his nearer approach he is seen to be Mr. B. In this mental process there is no surprise, neither is there in dreams where a person judged to be A is shortly seen as B. The same is true of objects ; and in this case of transformation, one or more of the objects in a dream scene may change without a corresponding change of the others, called for in nature. In this way places and things and persons never associated in our waking

experience are brought into juxtaposition, thus making it difficult to properly relate the parts of a dream to one another on waking.

A second method of transformation is by what I designate as *realized fancy*. In waking life, in viewing a scene or event I fancy certain modifications or expect certain things that do not occur, and properly should not occur except that the exuberance of fancy drags them in. In dreams I have similar fancies, but here I find them realized. If I picture to my imagination that I am at a certain distant place it does not take long before I am actually experiencing *passively* what a moment ago I was *actively* presenting to my mind. This is a fertile source of transformation in dreams. These transformations it is, that make it so difficult to remember dreams and to properly relate them ; for at times it seems as if an event might have two antecedents in a dream, as if one had a double consciousness for a short time, and had been enacting a rôle on two different fields at once, which in some unaccountable way became one field and one person. Perhaps it is only a difficulty of the rational mind in trying to remember what took place in a mind in which reason was dormant.

We are now prepared to discuss *methods* of record and of study of the record in connection with the results obtained by their application. One must accustom himself to holding the attention fixed upon the scenes of the dream world after waking in the morning and not allow the attention to be diverted for an instant to the scenes of the external world, or the superior strength of its impressions will instantly blot out the faint images of the dream. Then, by carefully reviewing the events of the dream it may be

more indelibly fixed on the memory. It is well, however, to have pencil and paper at hand and jot down the dream, at least skeletonwise, to aid in reconstructing it when the record is more carefully made. A single word in this way is sufficient to recall the dream by. Objects we meet in our daily walks, by a similar process, set us to feeling that some experience has passed in our life in connection with them somehow, and when the experience is unravelled it is found to be the fragment of a dream, which dream was either suggested by the object itself when it was scarcely noticed a day or two before, or if it had made a strong impression, that impression was made long ago, or else the object is similar in some way to the dream object so as to suggest it. One has to have his note-book with him all the time, for he knows not when an object may help him recall a dream. I find that the completeness with which a dream can be recalled, roughly speaking, depends inversely on the time which has elapsed between its occurrence and its first recollection. But a similar law governs all subsequent recollections. Thus if a dream be carefully rehearsed to fix it on the mind before rising, and a word or skeleton "suggestive" be made, should a portion of the day's activities intervene before the dream is recorded, the "suggestive" will aid in restoring much less of the details than if the scenes are fresher. The dream itself has all the completeness of nature, and if immediately observed by the active attention can be studied as a landscape is, except in the case of dreams one is allowed only a momentary peep at the scenery and then has to restore as much as he can recall. The dream records I have made are therefore very meagre compared with

the real dreams. The relation is exactly similar to that existing between a landscape itself and the description of a landscape by a passing tourist. But I find the impression of a natural scene, however short, is stronger than that made by these exceedingly faint images.

When I first began recording, the mind seemed so full of the subject that I would wake up during the night just to dream and to record dreams. So I had to put a sliding frame with a slit in it over my tablet to guide the pencil while writing, or else the lines would be superimposed in an undecipherable manner.¹ But this extreme zeal caused nervous prostration. It is a really exhausting process to keep the attention held on faint impressions in the presence of strong ones, and the effort to recall the faint details is also exhausting, so that I was compelled to adopt a more careless attitude of mind towards the record ; but I think the laws we shall subsequently reveal have not been thereby affected.

When the attention is turned to a dream scene passing in the mind, on awakening it can recall certain antecedent events that join onto the ones present, and so on back into the night ; though of course we must not let the time relations presented by the dream be any guide here, for one can dream of a year in a minute, or take part in events lasting hours in a moment. The dream stretches back and grows fainter and fainter until no more can be recalled. This seems to harmonize with the view that our morning dreams take place only during the passage from sleep to wake-

¹ Such writing, made by the sense of touch and motion, is crowded laterally as one feels that he passes over more space than in reality.

fulness, or while the blood pressure in the brain rises from a lower to a higher level.

Now, when the mind travels backward over a dream in the way last indicated, beginning with the dream scene present when just awakening, it goes backwards by jumps; that is, the dream has a moniliform or segmented character. It is a chain composed of links of more vivid scenes connected by scenes less vivid. The links only are recalled in the inverse order; the events inside each link are seen in their true progressive relations. When from any reason the scenes are less vivid, as from having allowed the outside world to intrude upon the attention, the fainter parts drop out, and these parts usually correspond to those details by which some principal object, person, or event of one link becomes by transformation the nodal or focal point of the succeeding link. In such a case the two links seem distinct and are recalled as distinct dreams, though the mind has a vague sense that they are only fragments of longer dreams without at the same time connecting them. Several links may be bound together into larger links. This appears to be due to the mental relations of the events themselves; but it has occurred to me that there might be a physiological explanation of this moniliform character in that the blood pressure varies with the pulse and respiratory movements, and as the waking period occupies a few of the larger and many more of the shorter waves, we here have something quite corresponding.¹ If the dreams are vivid, or if memory is good, then we have one long dream composed of many transformations. If the dream is less vivid we get a few fairly

¹See Mosso, "Über den Kreislauf des Blutes im menschlichen Gehirn," Leipzig, 1881.

long dreams, although some of these may be short and consist of but one node. Then if the dream has been very faint we get only a few scattered nodes of events, persons or places about which we dreamed, but we cannot recall details. We can also secure all these conditions by recording successive days in bed, or after rising, or after breakfast, or after dinner, or after supper, and if we wait until bedtime we can be glad if we are able to recall a single particle of dream. But suppose we make a practice of recording the dream, say just on awakening, then we shall find that some mornings we have the greatest degree of vividness and unity, and on others the least degree, and with all intermediate stages represented by different mornings. *It therefore follows that the number of dreams a person can recall has no direct significance, but only the total amount dreamed.* Guided by this law I proceeded to count the total number of words in the dream record of each day and to plot the curve for the whole time, and the results obtained we now proceed to discuss.

Some dreams are so vague that nothing of detail can be made out, but only that I dreamed about such or such thing, or that I recall a single object out of a dream scene. This object I have designated the node or focal point of greatest vividness. This node is the last to fade out, and if the dream scene was vivid enough it is by means of this node that the memory restores the accessory details. I divided the dreams into two classes, viz. those consisting of a single bare nucleus and those more complexly organized. In a table at the close of this paper I have grouped the daily records according to length from 1 to 900, which was the longest record for one day. Opposite each group I have placed the number of days that presented

records of that length, and in a third and fourth columns the corresponding number of dreams, complex and simple ; in two additional columns the average daily number of dreams ; and finally, the average length of the dreams. A little inspection shows us that the simple dreams tend to remain stationary, or to decrease in number as the record lengthens. The complex dreams, while increasing in number, do so at a rate of increment 100 times smaller, while the average length of dreams increases five times as rapidly as their number. As the unit of measurement is diverse in these cases, this relation simply means that the average length of all dreams is 100 words. These facts are in perfect accordance with the theory. It is total amount and not the number of dreams dreamed that measures the physiological action.

We have already seen how easily the length of the record for any day may be affected if the attention is called off, if one oversleeps so as to be hurried, and various other things occur to curtail the record. The two chief causes of disturbance are pressure of work and unusual experiences or occupation, excitement, etc., like a journey, for instance. I was able to pick out of my record thirty consecutive months which were fairly uniform in my experience, the great disturbing sources not having acted many days at a time during this period.¹ The first two weeks of my record show a steady rise in the curve, which is in accordance with the law that attending to one's dreams increases their number, *i. e.* increases the number we become aware of having. But this law ceased to operate after the climax was reached. The curve was seen to be very irregular,

¹ I later discuss a disturbing action which was present regularly during each May and June.

with a mixture of short and long records without apparent law; still one could discern a crowding together of the long records at certain points. A parallel curve of the moon's phases showed that the two curves were independent. I then chose the physiological or sexual month of 28 days and found there the period I sought. I thought that 30 months when summed would be sufficient to equate the petty disturbing influences, and thus I could get a curve approximately showing the actual state of affairs.

The table at the close of this paper shows the numbers from which the curve has been constructed. The nature of this curve and the fact that it was plotted for a menstrual period requires that we compare it with a curve representing the sexual condition. In the human female we have presented the monthly phenomenon of the katamenia lasting nearly a week. This phenomenon has relation to the functions of reproduction. Although the phenomenon is still not thoroughly understood, we have data¹ which show that during this period one or more Graafian follicles burst and set free ripe ova which are passed down the Fallopian tubes, and if fertilized, remain to be developed in the uterus. The cause of the bursting of the follicle is due to a congested condition of the ovaries, or a heightened blood pressure in them and accessory structures which may account for the uterine hemorrhage, but coitus may probably accomplish the same effect and thus prevent an impending menstrual flow. At any rate, after the flow has ceased an ovum is present in the tubes or uterus most favorably placed as regards fertilizability, and it is well known that the female is

¹See Geo. Arnold, "Zeitliche Verhältniss der Ovulation zur menstruellen Blutung." Würzburg, Dissertat. 1887.

most erotic and irritable at this time. The physical cycle is accompanied by marked psychical characteristics that gradually increase up to the period, and after a temporary decadence during the flow, present a sharp climax a week later. We shall term the first climax the *minor climax* and the second the *major climax*.

It is readily seen why the erotic state should be at its climax when the ovum is ready for fertilization. We have no direct means of measuring this condition as a curve, but we can do so indirectly. The first curve of the plate marked *A* is taken from Hermann's *Handbuch der Physiologie*, Bd. VI, part II, p. 74, and represents the frequency of conception with time-relation to the menstrual period. The two climaxes above noted are well shown, though the curve was plotted only with reference to a preceding menstrual period and not with reference to a subsequent one.¹ As the periods of women differ in length, the minor climax does not come out in its true sharpness and height. Undoubtedly there are other ways probably superior to this one of measuring this physiological period indirectly, but I am not aware that any available data have been gathered with reference to this point.

It would only seem natural that the male should also show a sexual period corresponding to that in the female, and that in well matched couples the climaxes would coincide. Concerning this point we read in Foster's *Physiology* (page 691, fourth English edition, 1883): "Within the year an approximately monthly period is manifested in the female by menstruation,

¹The dotted curve was plotted with reference to the close of the period, the other with reference to its beginning.

though there is no exact evidence of even a latent similar cycle in the male." On the other hand, in Dr. Hammond's "Treatise on Insanity," published the same year (page 114), we read, "Gall contended that there was a periodical manifestation in men analogous to that existing in females, . . . and Lévy holds a similar opinion. The latter states that 'young and robust persons do not notice this tendency unless their attention is specially directed to it, but men feebly constituted, or endowed with a great degree of irritability, or who have reached the period of their decline, perceive the alteration which their health monthly undergoes. . . . The feeling of discomfort is general and inexpressible, and the mind participates in it, for it is more difficult to maintain a train of ideas; a tendency to melancholy, or perhaps an unusual degree of irascibility, is joined to the indolence of the intellectual faculties. These modifications persist some days, and disappear of themselves.'

"I have certainly noticed in some of my friends this tendency to some monthly periodical abnormal manifestation . . . I think this is much more common than is ordinarily supposed, and that careful examination or inquiry will generally, if not invariably, establish the existence of a periodicity of the character referred to."

In my experience, young and robust persons are subject to recurrent periods of wakefulness at night, which, when they coincide with the full moon, are attributed to the action of its light. Undoubtedly the light of the moon has an independent action of this sort; but if Mantegazza's theory is correct, that the sexual period became established with relation to the lunar period because moonlight nights were favorable

to courting, there is a strong association existing between the moon's light and the excitation of the psychic-sexual functions. However, the period long ago became so firmly established as to run independently of the phases of the moon, and even to vary from its length so as to have a precessive relation to the moon's phases. The influence of that old institution, the Sabbath, must have had a powerful effect in fixing the period at twenty-eight days; but this period is easily influenced by exciting or nerve depressing causes, the former shortening the interval, and the latter delaying the period, or even preventing it to a great extent.

In the male as in the female, the maturation of the reproductive elements is a continuous process, though we may hardly say that it is not influenced by this mensal periodicity. It certainly is influenced by many incidental forces, such as food, temperature, exercise, occupation, sexual excitement, etc. But here, as in physics, we ought, I think, to consider each force still acting and producing its proper effects though the resultant may fail to reveal the direct action of any one element at a particular time. The mensal period is a steady force, the others are accidental and variable in time; hence if we take a sufficiently long period and summate by months, the disturbing forces will largely equate their effects, whereas the mensal force will thus reveal its true action. The presence of the reproductive elements exerts a constant stimulus upon the brain cells, which causes them to generate characteristic dreams that in turn react to produce expulsion of the gametal cells.¹ This *gonekbole*² will be more frequent at periods when the psychic cells are

¹ See Martin, *The Human Body*, Appendix, p. 13.

² *σπερμολία* is the more correct term, but scarcely as convenient.

most irritable, and therefore furnishes data for plotting the sexual curve in the case of the male, and the result is shown in curve *B* of the plate. As in the previous curve, it is only an *indirect* measure of the physiological rhythm we are considering. Here also we get two prominent cusps in the curve, in the form of a minor and a major climax, one week apart, and thus exactly corresponding to the climaxes in the case of the curve *A* of the female. The figures on which this curve is based are given in the table.

A similar treatment of the dream values gives us curve *C*. Here the two climaxes appear again in their corresponding positions, but approximately equal in value. In the sexual curve the climaxes fall on Tuesdays, while in the dream curve they occur on Wednesdays, a day later. The curve keeps near its average level between the climactic points. It sinks below the average during the two weeks succeeding the menstrual week, and as we approach this period it rises again, becoming in the case of the dream curve a marked climax during the week preceding the period. There is a curious descent in the curves (most marked in the case of the curve *C*) on Monday mornings. This must be due either to the influence of Sunday, or else to the fact that the mind is somewhat anxious as it is about to resume the cares of a new week, which anxiety acts probably as a constant factor in disturbing the completeness of the dream recollection.

It is an open question whether a rise in the dream curve represents increased power of recollection, or increased vividness of dreaming, or increased irritability, or all of these together. We are inclined to believe that the mensal period is at bottom a rhythm of the vital or psychic nature and influences probably all

the activities of mind and body. Hence these activities, when properly observed and measured, become indices of the more fundamental rhythm which they thus indirectly measure, or at least reveal. In the case of the knee jerk reported in the first number of this Journal it was shown how exceedingly sensitive it was in its responses, indicating diverse external and internal conditions and changes. It appears probable that had the experiments been conducted over a sufficiently long interval they would have revealed a monthly rhythm. We also suspect that a great many psychophysics reactions are modified by this rhythm, and the extent to which they are thus subject ought to be determined before we can rightly interpret the results.

Another question which occurs here is this, what sort of a rhythm is the mensal period? There is no fact in nature more prominent than the occurrence of periodicity, and these periods are of almost infinitely varied lengths and variously and complexly compounded. Many periods are secondary and resultant, being dependent on others. In physiology nearly all the periods are in relation to cosmic rhythms, to which they are related not as physical resultants but as vital (or intelligent) responses. The occurrence of the one is a "sign" to the protoplasm to act out the other. Yet we have hinted above that the living being may anticipate the stimulus and react at the proper time, in the absence of the stimulus, and thus have an independent rhythm of its own. How this is done is one of the mysteries of biology yet to be solved. We consider this sexual rhythm as belonging to this category.

When we analyze the figures that enter into the value of the dream curve, we find that several components are active in producing the result. Thus the

occurrence of the ekboles themselves has a modifying influence on the dream value, tending to raise it. But even when all the dream values coinciding with days of ekbole are thrown out and the remaining days summated, the character of the curve is not seriously altered, though of course reduced in value. Let us call the curve thus stripped of its over-tones, so to speak, the *fundamental*; then I found that an ekbole occurring at or near a minimal point had the power to raise the fundamental by a half of its value, but on a maximal point the increment became one fifth of the fundamental value; the average power of increment for all (mixed) cases being one fourth of the fundamental. The ratio of minimal cases to maximal cases, an equal number of each, is 1:1.11 in the compound curve, 1:1.41 in the fundamental, and 1:1.33 in the mixed or normal curve.¹ Although the relative value of the increment is less in the case of the maximal point than in that of the minimal point, the absolute value is about twice as great in the latter as in the former case. This is in accordance with what we should expect. The ekbole causes increased flow of blood to the brain, on the presence of which the dream value so largely depends. This increased flow is relatively more marked when the brain has less blood in it (at minimal points) than when it has a larger quantity of blood (as at maximal points).

When, therefore, an ekbole occurs, the dream value is raised by the ratio 1.25 as an average, and then it falls again to its normal value; but when only

¹ The curves in the plate, *i. e.* those obtained directly by plotting the results of observation, are "normal," or, in the present case, "mixed" where the summation of two sets of values is concerned; one set being unaccompanied and thus unaffected by ekboles, and therefore belonging to the fundamental system, and the other set affected by the presence of the ekboles, and therefore "compound."

one day intervenes before the next ekbole the fall is not so great, the ratio being here 1.10 : 1. The effect of an ekbole to raise the dream value is not so great when it is closely preceded by another ekbole, but in 33 cases presented by our data the ratio of the first to the second was 4903 : 6168 or 1 : 1.25. We shall proceed to show that this ratio, which seems to contradict the last statement, is due to the influence of the fundamental curve. When we analyze the cases more carefully we find that some of them contradict the result we obtained by addition. When these contradictory results are compared with the state of the fundamental curve, we find that in most cases the result has been due to the effect of this curve overcoming the effect properly due to the ekbole. Thus when we know that an ekbole raises the dream value, but we meet a case where a day free from ekbole just preceding or succeeding has a higher dream value, we find an explanation for such a phenomenon when we see that such day is nearer a maximal point than the ekbole day. This law is perfectly plain when we assume that each of the forces acts to contribute its effect independently of the others. The effect of an ascending curve raising all values and a descending one depressing them is readily seen in the tables. Now, therefore, analyzing the above ratio in this way, we have :

	Number of Cases.	Ratio.	Number of Cases.	Ratio.
First day greater than second.	6	1.40 : 1	12	1.92 : 1
Second day greater than first.	9	1 : 3.68	6	1 : 2.69
	Influence of curve is same way.		Influence of curve is contrary.	

The fact that so many cases show that the first day is the greater even when the influence of the curve is unfavorable leads us to announce the law as above, even though the ratio obtained by summation of all the cases is the reverse. But this ratio is a compound one, and we wish to eliminate the effect of the fundamental. Were we dealing with physical facts accurately determined, we should expect that the ratio 1.40 : 1 in the six cases where the first day is greater than the second (in accordance with the inferred law), when the fundamental assists this result, should be greater than that of 1.92 : 1 where the curve is contrary. This illustrates the peculiarity of physiological data. The element of disturbing influences is so great that exceptional cases are always occurring, especially when the number of cases is small as in this instance. For this reason, though we treat the numbers while performing computations as if they were accurate, we have no right to regard the results as accurate. They may be very inaccurate and even contrary to the truth. But by taking a large number of cases we are justified in regarding the results as *indicators*. Thus no significance can be attached to the particular form of our curves, but they simply indicate that there is a heaping up, as it were, of some influence at the occurrence of the menstrual interval. We should require an infinite number of cases to eliminate disturbances and make our figures have mathematical significance. This point deserves to be kept in mind while dealing with such a problem as this.

We saw above that the length of dreams increases nearly as fast as the increment in the daily record, that is, an average of 100 words must be added to the record to give an additional dream. We have also

seen that the occurrence of an ekbole raised the dream value by the ratio 1.25 as compared with the day preceding or succeeding. When the number of dreams are compared for this case, it is found that there is no difference in the number of simple dreams, but that the complex dreams are increased in number more rapidly than the record. Thus 164 cases of ekbole against their succeeding days gave an average ratio of 2.9 : 1.9. This signifies that the continuity of dreaming is by this influence broken. The fact, I think, is readily accounted for by the process of awakening that often accompanies the ekbole.

We have now to consider the annual variations. Each year contains 13 physiological months. Out of the 30 months from which I plotted the monthly curve, I chose 26 consecutive months for plotting the annual curve. I found that (as our table shows) there was a minimal point at March–April and a maximal point at November–December. The two years are closely similar in these respects. The dream value being the summation of 28 days is to be relied on for a curve, but the ekboles are too few, of course, to give a corresponding gonekbolic curve. We can readily perceive this on inspecting the number and seeing how one year contradicts the other. So we shall leave the ekboles out of consideration and seek to get at the sexual variations in a different direction. The two years combined give us curve *D* of the plate. It is quite plain that at the region of the winter solstice, rather more before than after it, the curve is maximal. It is also plain that the curve is minimal at the time of the equinoxes, the fall being in our curve greatest at the spring equinox. There is a slight rise at the approach of the summer solstice ; but when we compare the curves *E* and *F* in these respects our dream

curve seems sadly deficient. It is quite probable that this deficiency is due to the fact that about this time the change of life from the routine of study to the recreations of vacation acts detrimentally to the dream record. Indeed I know by experience that I was not so faithful in my records at this period as at other times.

In the animal and plant world the periods marked by the approach of the two solstices are marked by reproductive activities. This has relation to climate, of course, and not to the astronomical facts directly. The winter is provided against by well protected winter eggs and seeds; and in the case of mammals the gestation period has place during the winter that the young may be born at such a time as to have the advantages of summer. The direct effect of food and temperature in early summer is of course to nourish the reproductive systems, and where the young can be quickly matured reproductive activities are quickly instituted. Psychically the human male feels the approach of summer as a "spring fever," which is probably of sexual significance. To some extent Düsing¹ has worked at this problem and shown that the frequency of conceptions in the human being varies during the year, having maximal points at or near the solstices, but he finds the major climax at the summer solstice, and attributes the other rise in the curve, at the winter solstice, to the influence of the Yule festivities. Our curve *E* is taken from page 98 of his work, and represents the conceptions in Sweden, summated for 1851 to 1855.² Düsing also shows us

¹ Die Regulierung des Geschlechts Verhältnisse.

² The figures for Sweden do not show the marked climax in June which is true of other countries. The curve is, however, pertinent here, for comparison, as I am of Scandinavian blood.

the interesting fact that as the births increase the increment acts unequally on the production of the two sexes, the girl births suffering more variation than the boy births. Our curve F has been plotted from data furnished on pages 298 to 300 of his work. The ratio of boys to girls is given, and this ratio falls as conceptions increase in frequency. We have plotted the variation from the average ratio, and have moreover transposed the plus into negative so as to make the curve parallel with our other curves. It therefore shows variability in the girl births directly and in the boy births indirectly. There is of course no reason why of two variables one shall be rather chosen as a constant than the other. The dotted line represents the average ratio; ordinates above the line represent a fall in boys as compared with the girl births.

Now what seems plain on comparing all these curves is this, that in the monthly period the variation in the dream curve is parallel to that of the sexual curve; that in the annual curves the dream curve is parallel to the curves showing increased sexual activity, and these again to that showing the regulation of the sexual ratio; it follows, then, that we should expect that were a curve constructed showing the variations of the sexual ratio as related to the menstrual period, we would discover an important relation existing between the mensal rhythm and the production of sex. It seems to me the matter is well worth investigating. It has been supposed that the relative ages of the reproductive products and the relative state of "heat" in the sexes influence the sexual ratio, but this seems likely to be complicated by the influence of the sexual rhythm.

The months immediately succeeding the time for which we have summated our data were disturbed by

a trip to the tropics. In this case the approach of the summer solstice was aided by the action on the system of an unusual climate, the result being to vastly increase the record in the region corresponding to Dusing's major climax. This fact taken in connection with what we stated above tends to show that our annual dream curve is too low for the month of May.

TABLE SHOWING THE RATIO OF INCREMENT IN THE DAILY NUMBER OF DREAMS AND THEIR AVERAGE LENGTH, COMPARED WITH THE INCREASE IN THE DAILY RECORD.

Length of Daily Record in No. of Words.	No. of Days.	Total No. of Dreams.		Average Daily No. of Dreams.		Average Length of Dreams.
		Complex.	Simple.	Complex.	Simple.	
1 to 10	25	0	27	0.00	1.00	5
10 " 20	34	2	55	0.00	1.70	8
20 " 30	43	11	62	0.25	1.50	12
30 " 40	42	21	69	0.50	1.60	20
40 " 50	38	32	51	0.84	1.30	30
50 " 60	29	27	41	0.90	1.40	30
60 " 70	55	68	71	1.20	1.30	30
70 " 80	34	42	58	1.20	1.70	33
80 " 90	39	56	45	1.40	1.15	43
90 " 100	44	76	48	1.70	1.00	41
100 " 120	49	88	73	1.80	1.50	42
120 " 140	54	103	69	1.90	1.30	52
140 " 160	48	103	57	2.30	1.20	52
160 " 180	44	113	56	2.60	1.30	52
180 " 200	32	81	48	2.50	1.50	64
200 " 225	31	90	37	2.90	1.20	65
225 " 250	30	91	32	3.00	1.00	72
250 " 275	26	90	43	3.40	1.70	66
275 " 300	17	54	21	3.20	1.20	83
300 " 350	23	102	19	4.40	0.80	70
350 " 400	20	83	32	4.00	1.60	88
400 " 500	17	72	17	4.20	1.00	107
500 " 900	11	47	12	4.30	1.00	140

*Rule is that ratio of dream value, as averaged for all cases, positive and negative, is 1.25 on ekbole days as compared with non-ekbole days.

TABLE SHOWING THE RATIO OF THE DREAM VALUE ON EKBOLE DAYS TO DREAM VALUE ON DAYS PRECEDING AND SUCCEEDING, AND ANALYZED WITH REFERENCE TO THE STATE OF THE "FUNDAMENTAL."

Dream Value on Ekbole Day is Larger, i. e., Rule* Affirmed.			Dream Value is Smaller or Rule is Negatived.	
No. Cases.	Ratio to Preceding Day.	Ratio to Succeeding Day.	Ratio to Preceding Day.	Ratio to Succeeding Day.
25	23	16	17	
Fundamental Curve Is Neutral	2.45	2.47	2.20	2.20
No. Cases.	34	20	19	23
Curve Is Auxiliary.	2.90	2.61	2.27	2.06
No. Cases.	19	32	22	16
Curve Is Opposing.	2.39	2.42	2.04	1.17

TABLE

Showing the variation in the power of recollecting dreams (perhaps of dream activity or vividness), as measured by the number of words in the dream record, summated for a period of 30 physiological months, from November 24, 1884, to March 13, 1887. The variation in the sexual rhythm, as indicated by the number of gonekboles, is also shown.

MONTHLY VARIATION.				ANNUAL VARIATION.			
No. of Day.	Day of Week.	Dream Value.	Sexual (Ekbole) Value.	No. Mo.	Month beginning.	Ekboles.	Dream Value.
1	Mon.	3405	Pre-climax	3	1 Nov. 24	8 4267	Maximum —17792 1st 4 mos.
2	Tu.	3801		5	2 Dec. 22	5 5090	
3	Wed.	3331		5	3 Jan. 19	3 3912	
4	Th.	3192		7	4 Feb. 16	6 4523	
5	Fri.	3152		4	5 Mar. 16	5 4159	—13047 2d 4 mos.
6	Sat.	3214		8	6 Apr. 13	5 2961	
7	Sun.	3347		8	7 May 11	3 2674	
8	Mon.	3693	Anticipatory rise	2	8 June 8	1 3053	—10880 3d 4 mos.
9	Tu.	4025		6	9 July 6	1 2582	
10	Wed.	4341		7	10 Aug. 3	4 3150	
11	Th.	4571		5	11 Aug. 31	4 2746	
12	Fri.	4716		6	12 Sept. 28	4 2402	Total for 1885 = 47479
13	Sat.	4813		4	13 Oct. 26	5 5760	
14	Sun.	3589		7	14 Nov. 23	7 4853	
15	Mon.	3572	Minor Climax	5	15 Dec. 21	4 3627	Maximum —17900 1st 4 mos.
16	Tu.	3969		11	16 Jan. 18	5 5593	
17	Wed.	4999		9	17 Feb. 15	8 3827	
18	Th.	4116		6	18 Mar. 15	4 3507	—11316 2d 4 mos.
19	Fri.	3621	Here falls the menstrual period	7	19 Apr. 12	5 1189	
20	Sat.	4034		4	20 May 10	7 2830	
21	Sun.	3135		8	21 June 7	5 3790	
22	Mon.	3227	Major Climax	4	22 July 5	6 2534	—11883 3d 4 mos.
23	Tu.	3764		18	23 Aug. 2	6 2754	
24	Wed.	4741		8	24 Aug. 30	6 3710	
25	Th.	3333		4	25 Sept. 27	5 2885	Total for 1886 = 44038
26	Fri.	3644		6	26 Oct. 25	6 2949	
27	Sat.	2770		4	27 Nov. 22	8 4222	
28	Sun.	4462		5	28 Dec. 20	7 4581	Maximum
					29 Jan. 17	5 4287	
					30 Feb. 14	9 1536*	

*Owing to pressure of work, etc., the record for the 30th month was much reduced.

